



Physician Fact Sheet

PERCHLORATE

Environmental Epidemiology and Toxicology Division

HIGHLIGHTS: Perchlorate competitively inhibits the uptake of iodide by the thyroid gland potentially affecting thyroid function. Pregnant women and their developing fetus may be more susceptible to the effects of perchlorate because of the stress that pregnancy places on the thyroid gland. Disruption of thyroid function could put pregnant women at greater risk for pregnancy-related complications such as preeclampsia, placental abruption, and low birth weight infants. An adequate iodine intake may negate the potential effects. Exposure levels that affect thyroid function have not been well demonstrated in humans. Currently, a National Primary Drinking Water Regulation for perchlorate does not exist. For more information, call the Texas Department of Health Environmental Epidemiology and Toxicology Division at (800)588-1248.

What is Perchlorate?

Perchlorate (ClO_4^-) is the most oxygenated member of a series of compounds made up of chlorine and oxygen. It can form an acid or a salt in combination with a hydrogen ion (H^+) or another cation such as sodium, potassium, or ammonium ion. Perchlorate salts, which have been widely used as an oxidizer in solid propellants for rockets and missiles since the mid-1940s, have a finite shelf-life and must periodically be replaced. As a result, large volumes of perchlorate have been disposed of since the 1950s. Outdated disposal practices in the decades prior to modern environmental laws may have allowed perchlorate to contaminate groundwater. Perchlorates also are used in products like explosives, fireworks, road flares, air-bag inflation systems, lubricating oils, nuclear reactors, and electronic tubes. Processes of tanning and finishing leather, electroplating, aluminum refining, rubber manufacturing, and producing paints and enamels also may involve perchlorate compounds. In the past, physicians used perchlorate to treat Grave's Disease, a disorder that causes an overproduction of thyroid hormones. This practice was discontinued in the 1960s when aplastic anemia and other irreversible hematological side effects were observed in treated patients.

What Happens to Perchlorate in the Environment?

Perchlorate salts are inorganic compounds that readily dissolve in water. The perchlorate anion (ClO_4^-) is highly mobile in aqueous systems and can persist for many decades under typical groundwater and surface water conditions.

How does perchlorate get into the body?

Drinking water contaminated with perchlorate is the most likely way that perchlorate can get into the body. Perchlorate is not well absorbed through the skin.

What health effects are associated with perchlorate?

Perchlorate competitively inhibits the uptake of iodide by the thyroid gland through its effect on a transport molecule called the "sodium-iodide symporter" (NIS) which is responsible for the active transport of iodide into the thyroid. Iodine is an essential trace element that can be rate limiting in thyroid hormone synthesis. Because of this inhibitory effect, the adverse health effects associated with low-dose exposure to perchlorate are expected to be similar to those caused by iodine deficiency. Possible effects from low-dose exposure that have been theorized include a decrease in the production of thyroid hormones (T_3 and T_4), an altered metabolic rate, hypothyroidism, and thyroid tumors. Pregnant women and the developing fetus may be particularly susceptible to the effects of perchlorate exposure in drinking water, especially in the first and second trimesters of pregnancy. Pregnancy itself puts stress on the thyroid. Women with critically low levels of iodine may miscarry, or their developing fetuses can suffer congenital hypothyroidism which may stunt the fetus' growth and affect the proper development of the central nervous system.

Perchlorate Physician Fact Sheet Internet address is www.tdh.state.tx.us/epitox

Under these conditions pregnant women are at increased risk for pregnancy complications such as preeclampsia, placental abruption, and low birth weight infants. Exposure levels that affect thyroid hormone levels are not known and have not been well demonstrated in humans. In humans, serum perchlorate levels that resulted in iodine uptake inhibition ranging from about 15% to 70% showed no effect on either T4 or thyroid stimulating hormone (TSH). Since perchlorate competitively inhibits the transport of iodine into the thyroid, the lack of observable effect on thyroid hormone levels may be attributable to a high daily intake of iodine.

What recommendations are being made at this time?

We are making the general recommendation that pregnant women and children less than 3 years of age whose source water exceeds the Texas Commission on Environmental Quality's Interim Action Level (IAL) of 4 parts per billion (ppb) perchlorate use bottled water for cooking and drinking. Since perchlorate is not well absorbed through the skin, such water should be safe for other household purposes. Assuring an adequate dietary intake of iodine is recommended to reduce the likelihood of any potential adverse effects on thyroid hormone levels. Although we do not recommend routine biological testing, tests are available which could serve as biomarkers of exposure and effect.

Are there any medical tests to determine if exposure has occurred?

Circulating levels of T3, T4, and TSH may serve as biomarkers of exposure and effect for agents that disrupt thyroid-pituitary status. If you are concerned about a patient in a sensitive subpopulation, such as pregnant women, circulating T3, T4, and TSH levels can be monitored with blood chemistry assays.

Has the federal government made recommendations to protect human health?

Currently, a National Primary Drinking Water Regulation for perchlorate does not exist. In March 1998, perchlorate was listed as a contaminant that required additional research and occurrence information before regulatory determinations could be considered. Beginning January 2001, all large public water systems and a representative sample of small public water systems were required to monitor for perchlorate. The Texas Commission on Environmental Quality has established a health-based Interim Action Level (IAL) for perchlorate in drinking water of 4 parts per billion (ppb).

Where can I get more information? For more information, contact the Texas Department of Health, Environmental Epidemiology and Toxicology Division, 1100 West 49th Street, Austin, Texas 78756. Phone 1-800-588-1248, FAX 512-458-7222.